

United States of America

DRAFT PROPOSAL FOR THE WORK OF THE CONFERENCE

Agenda Item 1.2: to review and take action, as required, on No. **5.134** and related Resolutions **517 (Rev.WRC-97)** and **537 (WRC-97)** and Recommendations **515 (Rev.WRC-97)**, **517 (HFBC-87)**, **519 (WARC-92)** and Appendix **11**, in the light of the studies and actions set out therein, having particular regard to the advancement of new modulation techniques, including digital techniques, capable of providing an optimum balance between sound quality, bandwidth and circuit reliability in the use of the HF bands allocated to the broadcasting service.

Background Information: This agenda item is directed towards the operational use of digital modulation techniques for broadcasting in the HF bands. There has been sufficient progress in ITU-R SG 6, so that the digital modulation techniques to be considered under this agenda item are limited to just the digital modulation techniques recommended in Recommendation ITU-R **BS.1514**. WRC-2003 will therefore be fully competent to set any necessary conditions for introducing these digitally modulated emissions to the HF bands allocated to broadcasting.

The collection of all the articles, resolutions and recommendations listed in the agenda item text are the ones that will need to be reviewed for suppression or modification in the light of the progress that has been made in the intervening years for digital modulation use in the HF broadcasting bands. To complete the overall need, some additions will have to be made. The suppressions, modifications and additions that are incorporated in the U.S. proposal form an integrated package that deals in an efficient manner with all the aspects of the consequent needs connected with this non-allocation agenda item. By and large, the specific wording of these suggested changes are those that were developed within the ITU-R's Study Group 6 at its WP6E meetings during 2001.

Recommendation ITU-R **BS.1514**, mentioned above, is a system recommendation, wherein the acceptable digital modulation techniques are recorded. The development and testing of this modulation, including its various "modes" associated with different levels of robustness and audio quality, has brought the techniques close to consumer product status. It is expected that by the end of 2003, or not long thereafter, there will be on the market receivers that include a HF digital capability. In addition, modern HF transmitters can accept these digital signal inputs.

It is because of this progress that this agenda item and this proposal exist -- and, without diminishing broadcaster and listener access to traditional amplitude modulation, simply permits digital modulation in the mix of acceptable and available listening.

Furthermore, since the introduction of digital modulation for operational use is two years or so from 2002, the proposed modifications to existing articles, resolutions and recommendations treat all HF broadcasting bands on an equal footing. There is no longer any compelling reason to separate the conditions of use of the "WARC-92" bands from the other HF broadcasting bands. The solution proposed is to modify Article footnote **5.134** so that any ITU-R approved amplitude modulation or digital modulation can be broadcast in the "WARC-92" bands after 1 April 2007. Before that time, the proposal is not to permit broadcasting in these bands, other than on a non-harmful interference basis (as is the current situation using **4.4**).

Three resolutions and recommendations are proposed to be suppressed since they are no longer relevant. They are noted at the end of the proposal, with appropriate reasons.

Proposals:

USA/ /1 MOD

RESOLUTION 517 (REV.WRC-03)(~~REV.WRC-97~~)

~~Introduction of digitally modulated and single-sideband emissions~~~~Transition from double-sideband to single-sideband or other spectrum-efficient modulation techniques in the high-frequency bands between 5 900 KHz and 26 100 KHz allocated to the broadcasting service~~

The World Radiocommunication Conference (Caracas, ~~1997~~2003),

considering

- ~~a) that digital techniques are being introduced into many existing services ~~the high-frequency (HF) bands allocated to the broadcasting service between 5 900 kHz and 26 100 kHz are severely congested;~~~~
- ~~b) that digital and single-sideband (SSB) techniques allow more ~~efficient~~ effective utilization of the frequency spectrum than double-sideband (DSB) techniques;~~
- ~~c) that digital and SSB techniques enable reception quality to be improved;~~
- ~~d) that recommendation 515(Rev.WRC-97) encourages the acceleration design and manufacture of SSB transmitters and receivers;~~
- ~~e) Appendix 11 concerning the digital and SSB system specifications in the HF broadcasting services;~~
- ~~f) that rapid developments are taking place in digital sound broadcasting technologies;~~
- ~~e) that ITU-R in its Recommendation ITU-R BS.1514 has recommended system characteristics for digital sound broadcasts in the broadcast bands below 30 MHz;~~
- ~~g) that digital modulation techniques are expected to provide the means to achieve the optimum balance between sound quality, circuit reliability and bandwidth;~~
- ~~h) that digitally modulated emissions can, in general, provide more efficient coverage than amplitude-modulated transmissions by using fewer simultaneous frequencies and less power;~~
- ~~h) that it is economically attractive, using current technology, to convert modern conventional DSB broadcasting systems to ~~SSB~~ digital operation in accordance with *considering d)* above;~~
- ~~i) that some DSB transmitters have been used with digital modulation techniques without transmitter modifications;~~
- ~~l) that the lifetime of a receiver is of the order of ten years;~~
- ~~m)k) that ITU-R is carrying out urgent further studies on the development of broadcasting using digitally modulated ~~emissions~~ in the bands allocated to the broadcasting service below 30 MHz;~~
- ~~n) that other spectrum-efficient modulation techniques may be developed in the future;~~

resolves

1 that the early introduction of digitally modulated emissions as procedure in the Annex to this Resolution shall be used for the purpose of ensuring an orderly transition from DSB to SSB or other spectrum-efficient modulation techniques recommended by ITU-R in the HF bands between 5 900 kHz and 26 100 kHz allocated to the broadcasting service is to be encouraged;

2 that digitally modulated and SSB emissions shall comply with the characteristics specified in Appendix 11;

3 that whenever an administration replaces a DSB emission by an emission using digital or SSB modulation techniques, it shall ensure that the level of interference is not greater than that caused by the original DSB emission, and shall use RF Protection values specified in Recommendations **DAB (WRC-03)** and **517 (Rev. WRC-03)**;

~~24 that the final date for the cessation continued use of DSB shall be periodically reviewed by a competent future world radiocommunication conference in the light of the latest available complete statistics on the capability of administrations to introduce digital systems worldwide distribution of SSB and other spectrum efficient modulation technique transmitters and receivers, as called for in Resolution 537 (WRC-97),~~

instructs the Director of the Radiocommunication Bureau

to compile and maintain the statistics referred to in *resolves* 24, to make these statistics available to administrations and to submit summaries thereof to a competent future world radiocommunication conferences,

invites ITU-R

to continue its studies on digital techniques in HF broadcasting ~~as a matter of urgency~~ with a view to assist in the development of this technology for future use,

invites administrations

1 to assist the Director of the Radiocommunication Bureau by providing the relevant statistical data and to participate in ITU-R studies on matters relating to the development and introduction of digitally modulated emissions transmissions in the HF bands between 5 900 kHz and 26 100 kHz allocated to the broadcasting service;

2 to bring to the notice of transmitter and receiver manufacturers the most recent results of relevant ITU-R studies on spectrum-efficient modulation techniques suitable for use at HF as well as the information referred to in considerations d) and e).

Reasons: The changes to this resolution reflect the introduction of digital and SSB emissions and the consequent need to protect DSB emissions from digital and single sideband emissions, and vice versa. The introduction of digital emissions does not substitute for single sideband emission use. The resolution has been modified so that both are considered on an equal regulatory footing. Several modifications made in the *considerings* are a consequence of digital modulation development for HF broadcasting since WRC-97.

USA/ 2 SUP

ANNEX TO RESOLUTION 517 (REV.WRC-97)

Reasons: Due to the modifications to Resolution 517 related to the introduction of digital and SSB emissions and deletion of the requirement of the transition procedures, this annex is no longer needed. This annex deals with a previous idea that all DSB would cease after 2015. The complete package with regard to this agenda item considers that this concept of cessation of one of the approved modulation methods should be considered by a future competent conference; that it is unrealistic to consider ceasing a particular type of modulation without any concern for the listener and broadcaster market 12 years after WRC-03.

USA/ /3 **MOD**

APPENDIX 11

System specifications for Double-Sideband (DSB), and Single-Sideband (SSB) and Digitally Modulated Emissions ~~System Specifications~~ in the HF Broadcasting Service

Reasons: Updating the appendix title to reflect the proposed use.

USA/ /4 **NOC**

Double-sideband system (DSB)

Reasons: The current text is adequate as written.

PART B - Single-sideband system (SSB)

1 System parameters

USA/ /5 **MOD**

1.1 Channel spacing

In a mixed DSB, SSB and Digital environment ~~During the transition period~~ (see Resolution **517 (Rev. WRC-03 HFBC-87)**), the channel spacing shall be 10 kHz. In the interest of spectrum conservation, ~~during the transition period~~, it is also permissible to interleave SSB emissions midway between two adjacent DSB channels, i.e., with 5 kHz separation between carrier frequencies, provided that the interleaved emission is not to the same geographical area as either of the emissions between which it is interleaved.

In an all inclusive SSB environment, ~~After the end of the transition period~~ the channel spacing and carrier frequency separation shall be 5 kHz.

Reasons: Updating this text to reflect digital and SSB use and deleting text concerning the transition period. No change in the carrier reduction levels.

USA/ /6 **MOD**

2.6 Carrier reduction (relative to peak envelope power)

In a mixed DSB, SSB and Digital environment ~~During the transition period~~ the carrier reduction shall be 6 dB to allow SSB emissions to be received by conventional DSB receivers with envelope detection without significant deterioration of the reception quality.

In an all inclusive SSB environment ~~At the end of the transition period~~, the carrier reduction shall be 12 dB.

Reasons: Updating this text to reflect digital and SSB use and deleting text concerning the transition period. No change in the carrier reduction levels.

USA/ /7 **ADD**

PART C - Digital system

1 System parameters

1.1 Channel spacing

The initial spacing for digitally modulated emissions use shall be 10 kHz. However, interleaved channels with a separation of 5 kHz may be used in accordance with the appropriate protection criteria appearing in Recommendation **DAB (WRC-03)**, provided that the interleaved emission is not to the same geographical area as either of the emissions between which it is interleaved.

1.2 Channel utilisation

Channels using digitally modulated emissions may be commingled with analogue emissions in the same HFBC band provided the protection to the analogue emissions is at least as great as that which currently is in force with analogue-to-analogue protection. To accomplish this may require that the digital spectral power density (and total power) be lower by several dB than is currently used for the same emission circuit using either DSB or SSB emissions.

2 Emission characteristics

2.1 Bandwidth and centre frequency

A full digitally modulated emission will have a 10 kHz bandwidth with its centre frequency at any of the 5 kHz possibilities within the HFBC bands.

There are “simulcast” modes, which are a combination of analogue and digital emissions of the same programme in the same channel, that may use a digital emission of 5 kHz or 10 kHz bandwidth, next to either a 5 kHz or 10 kHz analogue emission. In all cases of this type, the 5 kHz interleaved raster used in HFBC shall be adhered to in placing the emission within the HFBC bands.

2.2 Frequency tolerance

To be entered after WP6E determines the values at its September 2002 meeting.

2.3 Audio frequency band

Digital source coding within a 10 kHz bandwidth, taking account of the need for various levels of error avoidance, detection and correction coding emission mitigation, can range from the equivalent of monophonic FM (approximately 15 kHz) to low level speech codec performance of the order of 3 kHz. The choice of audio quality is connected to the needs of the broadcaster/listener, and includes such characteristics to consider as the propagation channel conditions expected. There is no single specification, only the upper and lower bounds noted in this paragraph.

2.4 Modulation

Quadrature amplitude modulation (QAM) with Orthogonal frequency division multiplexing (OFDM) shall be used. 64 QAM is feasible under many propagation conditions; factors of 1/2, 1/4 and perhaps 1/8 of this are specified for use when needed.

Reasons: Part C is added to address the requirements of digital systems. Specific channelization values, audio frequency bandwidths and “modes” of digital modulation conform to ITU-R system Recommendation **BS.1514**.

USA/ /8 ADD

DRAFT RECOMMENDATION DAB (WRC-03)

RF protection ratios associated with digitally modulated emissions in the HF bands allocated exclusively to the broadcasting service

The World Radiocommunication Conference (Caracas, 2003),

considering

- a) that this Conference has resolved to encourage the introduction of digitally modulated emissions in the high frequency broadcast bands allocated exclusively to the broadcasting service;
- b) that the current use of the spectrum is based on the use of double-sideband (DSB) emissions;
- c) that RF co-channel and adjacent channel protection ratios are among the fundamental parameters when determining compatibility;
- d) that this Conference has adopted Resolution **517 (Rev. WRC-03)** relating to the introduction of digitally modulated emissions in the HF bands allocated exclusively to the broadcasting service;
- e) that Part C of Appendix **11** contains digital system specifications that refer to this recommendation for matters dealing with appropriate protection ratios,

recommends

1 that in the application of Article **12**, the protection ratios specified in the Annex to this Recommendation be used for all those cases where digitally modulated emissions operate in the same bands as double-sideband analogue emissions.

Reasons: This resolution provides protection ratios associated with digital emissions in the same manner as that of Recommendation **517**, originally from HFBC-87, which deals with SSB and DSB only. It, along with its annex, specifies the levels of protection required both to protect the amplitude modulation transmissions from digital modulation emissions, digital modulation emissions from other digital modulation emissions, and digital modulation emissions from amplitude modulation emissions.

USA/ /9 ADD

ANNEX TO RECOMMENDATION DAB (WRC-03)

RF protection ratio values

1. In accordance with Resolution **517 (Rev. WRC-03)** digital modulation may be used in any of the HF bands allocated exclusively to the broadcasting service. This accommodation has to be made with the appropriate amounts of protection given to both analogue and digital emissions. RF protection ratios are part of the overall regulation of these emissions. Their values appear in the table in this annex.
2. The table consists of RF protection ratios for co-channel and adjacent channel conditions. The independent variable in the table is the centre frequency separation in kHz of any pair of emissions, wanted vs. unwanted. The ratio data are in decibels.
3. The digital modulation governing these protection ratios is that which appears in summary in Part C of Appendix **11**, as revised at this conference, and the analogue modulation is double-sideband

modulation or single sideband modulation as summarized in Parts A and B, respectively, of the same Appendix.

Protection Ratio Table

Wanted signal	Other signal	Centre frequency separation (kHz)				
		0	5	10	15	20
DSB	Digital ¹⁾	6	3	-31	-42	-48
Digital	DSB ²⁾	8	2	-31	-38	-40
Digital	Digital ²⁾	17	12	-35	-39	-44
SSB	Digital ³⁾	-	-	-	-	-
Digital	SSB ³⁾	-	-	-	-	-

Notes:

- 1) Values relative to the DSB/DSB co-channel RF protection ratio
- 2) Values for a BER of 10⁻⁴
- 3) Values for SSB into digital and digital into SSB will be supplied from the TG6/7 meeting to be held in September 2002.

Reasons: This annex provides the appropriate amounts of protection given to both analogue and digital emissions and supports the text of DRAFT RECOMMENDATION **DAB (WRC-03)**.

USA/ /10 MOD

RECOMMENDATION 517 (~~HFBC-87~~REV.WRC-03)

Relative RF protection ratio values for single-sideband (SSB) emissions in the HF bands allocated exclusively to the broadcasting service

The World Administrative Radio Radiocommunication Conference for the Planning of the HF Bands Allocated to the Broadcasting Service (Caracas, 2003-1987),

considering

- a) that ~~WRC-97 the Conference has adopted~~ Article 12 as the seasonal a method for the planning procedure for of the HF bands allocated exclusively to the broadcasting service;
- b) that this ~~method~~ procedure is based principally on the use of double-sideband (DSB) emissions;
- c) that the RF co-channel protection ratio is one of the fundamental planning parameters;

~~d) that the this Conference has adopted Resolution **517 (Rev. WRC-03)** relating to the transition introduction of digitally modulated and from DSB to SSB emissions in the HF bands allocated exclusively to the broadcasting service and Recommendation 515 relating to the introduction of transmitters and receivers capable of both DSB and SSB modes of operation;~~

~~e) that the SSB system characteristics for HF broadcasting are contained in Appendix **11**;~~

~~f) that, however, due to their provisional nature, the values of the relative RF protection ratio to be applied for all relevant combinations of wanted and unwanted DSB and SSB emissions have not been included in the Appendix mentioned in considering e);~~

~~g) that preliminary studies have shown that SSB emissions may require a lower RF co-channel protection ratio for the same reception quality;~~

~~h) Resolution 514 (HFBC 87)* relating to the procedure to be applied by the Radio Regulations Board and the Bureau in the revision of relevant parts of their Technical Standards used for HF broadcasting;~~

recommends

~~that, subject to the procedure to be applied by the Radio Regulations Board and the Bureau in the revision of relevant parts of their Technical Standards used for HF broadcasting given in Resolution 514 (HFBC 87)*, the values of relative RF protection ratio given in the Annex to this Recommendation be used by the Bureau in its application of Article 12 Technical Standards relating to SSB and DSB emissions in the HF bands allocated exclusively to the broadcasting service,~~

invites the ITU-R

~~to continue to study the values of relative RF protection ratio for the different cases and frequency separations covered in the Annex to this Recommendation;~~

and recommends administrations

~~to participate actively in these studies.~~

Reasons: This recommendation has been modified to reflect the introduction of digital emissions. No substantive changes were made in the protection ration values with SSB vs. DSB amplitude modulation.

USA/ 11 MOD

ANNEX TO RECOMMENDATION 517 (HFBC 87) Rev.WRC-03

Relative-RF protection ratio values

1 The values of ~~relative~~-RF protection ratio given in the table should be used whenever SSB emissions in conformity with the specification in Appendix **11** are involved in the use of the HF bands allocated exclusively to the broadcasting service.

~~2 The values given refer to the case of co-channel DSB wanted and unwanted signals for the same reception quality.~~

~~3₂ For the reception of DSB and SSB (6 dB carrier reduction relative to peak envelope power) wanted signals, a conventional DSB receiver with envelope detection designed for a channel spacing of 10 kHz is assumed.~~

~~* This Resolution was abrogated by WRC-97.~~

43 For the reception of an SSB wanted signal (12 dB carrier reduction relative to peak envelope power), the reference receiver as specified in Appendix 11, Part B, Section 3, is assumed.

54 SSB signals with 6 dB carrier reduction relative to peak envelope power assume equivalent sideband power as specified in Appendix 11, Part B, § 1.2.

65 The figures for case 2 in the following table relate to a situation where the centre frequency of the intermediate frequency pass-band of the DSB receiver is tuned to the carrier frequency of the wanted SSB signal. If this is not the case, the value for a difference of +5 kHz may increase to -1 dB.]

Relative RF protection ratio values with reference to the co-channel RF protection ratio for DSB wanted and unwanted signals (dB)¹ for use in the HF bands allocated exclusively to the broadcasting service

	Wanted signal	Unwanted signal	Carrier frequency separation $f_{\text{unwanted}} - f_{\text{wanted}}, Df$ (kHz)								
			-20	-15	-10	-5	0	+5	+10	+15	+20
1	DSB	SSB (6 dB carrier reduction relative to p.e.p.)	-51	-46	-32	+1	3	-2	-32	-46	-51
2	SSB (6 dB carrier reduction relative to p.e.p.)	DSB	-54	-49	-35	-3	0	-3	-35	-49	-54
3	SSB (6 dB carrier reduction relative to p.e.p.)	SSB (6 dB carrier reduction relative to p.e.p.)	-51	-46	-32	+1	0	-2	-32	-46	-51
4	SSB (12 dB carrier reduction relative to p.e.p.)	SSB (12 dB carrier reduction relative to p.e.p.)	-57	-57	-57	-45	0	-20	-47	-52	-57

¹ Frequency separation Δf less than -20 kHz, as well as Δf greater than 20 kHz, need not be considered.

Reasons: Minor text changes were made to update the annex from **HFBC-87**. No changes were made in the DSB vs. SSB table of protection ratios.

USA/ /12 MOD

5.134 ~~The use of the bands 5 900-5 950 kHz, 7 300-7 350 kHz, 9 400-9 500 kHz, 11 600-11 650 kHz, 12 050-12 100 kHz, 13 570-13 600 kHz, 13 800-13 870 kHz, 15 600-15 800 kHz, 17 480-17 550 kHz and 18 900-19 020 kHz by are allocated to the broadcasting service on a primary basis as from 1 April 2007 is limited to single sideband emissions with the characteristics specified in Appendix 11 or to any other spectrum efficient modulation techniques recommended by ITU-R. Access to these bands shall be subject to the decisions of a competent conference.~~

Reasons: The proposed modification provides a simple unambiguous regulatory environment for the use of the WARC-92 extension bands both before and after the envisaged implementation date of 1 April 2007. Before the 01/04/07 date, there is no change: in other words, the bands are not allocated to HFBC. After that date, broadcasters can choose any modulation means that has ITU-R approval, such

as the digital modulation described in ITU-R Recommendation **BS.1514** and the SSB and DSB amplitude modulations noted in Article **11**.

USA/ /13 SUP

RESOLUTION 537 (WRC-97)

Reasons: The survey mentioned in the resolution on transmitter and receiver statistics related to SSB has been completed, and submitted by the BR for WRC-2000, as requested from WRC-97. Therefore, there is no need to carry forward this resolution. The associated Recommendation **515 (Rev.WRC-97)** is also proposed for suppression as detailed below.

USA/ /14 SUP

RECOMMENDATION 515 (Rev.WRC-97)

Reasons: With the adoption of this Recommendation **BS.1514** and the fact that IEC has been informed of this development, Recommendation **515 (Rev.WRC-97)** can be suppressed.

USA/ /15 SUP

RECOMMENDATION 519 (WARC-92)

Reasons: This Recommendation, from WARC-92, considers the possibility of advancing the date of cessation of DSB. In the light of broadcasting needs in HF, this is totally unrealistic. Thus, there is concern within many Administrations, expressed on many occasions at WRC-97, that the introduction of SSB into HF Broadcasting (and now digital modulation) should not restrict the ability of administrations to continue with their existing DSB transmissions for the foreseeable future and that at this point in time it is inappropriate to specify a cessation of DSB in favour of SSB in the year 2015. It is also evident from information presented at WRC-2000 by the Director that the interest in SSB within HF Broadcasting is virtually non-existent. This Recommendation should therefore be suppressed.

USA/ /16 MOD

ARTICLE 23.12

~~Double sideband and single side band~~ Transmitting stations operating in the HF bands allocated exclusively to the Broadcasting Service shall meet the system specifications contained in Appendix **11**.

Reasons: A consequential change that reflects the change in Appendix **11** that has added digital modulation to the acceptable modulation methods.